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DOUBLE RAIL RESTRAINER FOR HANDLING BEEF CATTLE

by

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**SUMMARY:**

A new double rail conveyor restrainer for handling cattle at the slaughter plant is described. It has improved safety and ergonomics compared to the V restrainer conveyor it replaces. Cattle ride astride a moving conveyor. This design could also be adapted for veterinary work.

**KEYWORDS:**

slaughterhouses  
cattle  
chutes  
restraint  
handling

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## Introduction

For the last fifteen years, large beef slaughter plants have been using the V restrainer system for restraining cattle during stunning and shackling. It was invented by Edwards (1972), Schmidt (1972) and Willems and Markey (1972). A complete description of the system can be found in Grandin (1983). The V restrainer was a major humane and safety improvement over old style knocking boxes, but there were still problems with it. Cattle balked at the entrance and the stunner operator had to reach excessively to place the captive bolt stunner in the animal's forehead. Researchers at the University of Connecticut developed a laboratory prototype double rail restrainer for calves and sheep (Giger et al 1977, and Westervelt et al 1976). Grandin (1988.) developed an improved entrance and animal size adjustment mechanism for this system and installed it in a commercial calf and sheep slaughter plant in 1986. In this paper, the development and construction of the double rail system for adult cattle and feedlot steers will be described. The first commercial installation was in a plant which slaughtered 240 steers per hour.

## Description of the System

The double rail system layout, elevation and cross section are shown in Figures 1,2,3 and 4. the basic operation of the system is similar to the V restrainer and double rail systems described in Grandin (1983, 1988a). The system consists of a single file entrance ramp, double rail conveyor, shackle rail, table conveyor and incline conveyor.

Cattle walk up a ramp to the restrainer entrance and straddle a stationary leg spreader bar which positions their legs on each side of the moving double rail conveyor. While the animals ride astride on the moving double rail, they are stunned with a captive bolt and the shackle is attached to one rear leg. The stunned animals are discharged off the double rail onto a moving table conveyor. The shackle trolley is then picked up by a moving inclined conveyor which moves the stunned shackled animal to the bleed area.

### Entrance Design

The top of the double rail conveyor flites where the animals ride astride must have a minimum height of 213 cm above the plant floor. The entrance chute floor is even with the top of the conveyor flites. Cattle walk up a single file ramp to a level entrance chute. Design specifications for ramps and crowd pens for bringing cattle in single file up to the entrance chute can be found in Grandin (1979, 1983, 1984, 1986, 1990). There should be a minimum of 3 m of level chute floor prior to the cleated non-slip entrance ramp. The leg spreader bar is 45cm high and a cross section is shown in Figure 3. This bar positions the animal's legs on each side of the conveyor. The animal then walks down a cleated non-slip entrance ramp

located on each side of the conveyor. (Figure 5) This ramp is on a 25 degree angle. A solid false floor prevents entering animals from seeing the 200 cm drop off below the conveyor. When the animals become high centered, they are moved along by the conveyor while supported by their briskets and bellies. The leg spreader bar that runs parallel to the entrance ramp is low enough to allow the animals to walk on the cleated ramp. However, the animal's feet do not touch the false floor while they are riding astride the conveyor. A solid hold down rack guides the animals down onto the conveyor and prevents rearing and jumping. The level position of the hold down rack is 183 cm long. The hold down rack is long enough so that all four feet are off the entrance ramp before the animal's head emerges from under the hold down rack. The slanted portion of the hold down rack is positioned to provide 10cm of clearance between an entering animal's back and the underside of the hold down rack.

### Conveyor and Adjustable Side Design

The double rail conveyor consists of metal segment flites attached to a chain. It is similar to the conveyor described in Grandin (1988A). The moving portion of the conveyor is 26.6cm wide and 6.5m long. It has a depression in the center to fit the animal's brisket (Figure 6). The depression for the animal's brisket (sternum) is 7.60 cm deep and 7.60cm wide at the top. The double rail configuration is formed by three smoothly intersecting arcs. The stationary conveyor framework is 30cm wide.

The adjustable side design is also similar to the design used in the calf restrainer (Grandin 1988). Figure 4 schematically illustrates the position of the adjustable sides for both small 225kg cattle and large 800kg cattle. Hydraulic cylinders connected to mechanical linkages move the sides. The adjustable sides press loosely against the upper position of the animal's body. A gap below the bottom edge of the adjustable sides provides space for the shoulder joints. When the sides are in the position for the smallest cattle, there is a 15cm gap between the bottom of the adjustable sides and the top of the double rail restrainer conveyor flites. To prevent injuries to the shoulders of incoming cattle, the adjustable sides are equipped with spring loaded flapper gates to guide the cattle between them.

### Stunning and Shackling

Cattle are stunned with a captive bolt when their heads emerge from underneath the level position of the hold down rack (Figure 7). The platform that the stunner operator stands on, is even with the top of the conveyor flites (Figure 4). The stationary sides of the stunner operator's side is 91cm high. Shackling is accomplished after the animal is stunned while it is still astride the conveyor. After shackling, the stunned animals are discharged onto the conveyor table and go up an incline conveyor. These components are the same as those used with the V



restrainer (Grandin 1983).

### **Safety and Ergonomic Advantages**

Ergonomic measurements by Industrial Biomechanics Inc. of Oak Ridge, North Carolina indicated that back strain for the stunner operator is significantly reduced. There is a reduction of pressure of 28kg at the lumbar 5/sacral 1 level. Back strain is reduced because the stunner operator can stand 28 cm closer to the animal. He can stand straighter because he no longer has to reach over the return portion of the V restrainer conveyor (Figure 8). The stunner operator of a V restrainer has to constantly lean over the restrainer (Figure 8).

Improved ergonomics for the stunner operator also results in more accurate and humane stunning. The percentage of poorly stunned cattle has been cut in half. Poorly stunned cattle are an extreme safety hazard to people working in the line because they often kick employees. At one plant, the reduction in poorly stunned cattle paid for the double rail restrainer in 6 months by reducing line stoppages. Line stoppages cost up to \$200 per minute in large plants. Another major safety advantage is that it is extremely difficult for live cattle to escape from the restrainer and get out on the stunner operator's platform. The high, solid sides hold the animals in (Figure 9). In a V restrainer, cattle escape onto the stunner operator's platform much more frequently.

The double rail restrainer also improves ergonomics and working conditions for the shackler. Shackling is easier because the hind legs are spread apart. The shackler also stays cleaner because he does not have to get under the restrainer to shackle the hind leg.

### **Efficiency and Humane Advantages**

Cattle enter the double rail restrainer more easily because they can walk in with other legs in a normal position. In the V restrainer, the legs must be pushed together. Less prodding is required to induce cattle to enter the double rail system. At one plant, the author was able to move four out of five cattle into the restrainer without the use of an electric prod. The line speed at this plant was 350 head per hour. Employees at three plants had to be retrained not to bunch cattle together. Bunching cattle together improves entering efficiency in the V restrainer, but it causes some cattle to get their legs in the wrong position in the double rail. Cattle will always position their legs on each side of the leg spreader bar if they are allowed to walk in without being bunched together. When cattle are driven gently, they will walk in willingly.

Observations also indicated that the solid false floor is essential to induce cattle entry. The entrance ramp must have non-slip cleats because cattle will become scared and attempt to back out if they slip. In several plants, cattle entry was also facilitated by installing overhead sodium light fixtures about 3m above the restrainer at the stunning position. Cattle were also quieter and entered more easily

in three plants which had engineered their hydraulic systems to reduce high frequency noise. Cattle are more sensitive to high frequency noise than people (Ames, 1974).

Cattle ride more quietly in the double rail. Rearing and struggling is reduced compared to a V restrainer. At one plant, cattle sat quietly in the double rail restrainer during a two hour break down.

Observations at two slaughter plants indicated that the length of the level portion of the solid hold down has a tremendous effect on cattle behavior. Lengthening the hold down rack had a very calming effect on the cattle. It is absolutely essential that the hold down rack is long enough so that all four of the animal's feet are off the entrance ramp before it's head emerges from under the hold down. The hold down blocks the animal's vision and it may have a similar effect as the "dark box" chute which is used for artificial insemination of cattle (Hale and Friend 1987). Blocking an animal's vision has a calming effect and reduces stress (Douglas et al 1984, Kinsman 1986). The calming effect of a longer hold down rack may also be due to "making the animal feel restrained". The system works more efficiently and the cattle stay calmer if they are completely settled down on the conveyor before they come out from under the hold down. If space in a plant permits a level hold down longer than 182cm, it would provide a further calming effect.

The double rail restrainer also provides the advantage of easier adjustment for different sized cattle. In some plants, small cattle fell through the bottom of the V restrainer because it is difficult to adjust the width between the two conveyors. The double rail is easily adjusted by moving the adjustable sides. Two other advantages of the double rail are lower cost and it is compatible with existing shackling, ramps and conveying systems used with V restrainers. In three plants, a V restrainer was replaced with a double rail. Converting a V restrainer system to double rail can be easily accomplished in one three day weekend.

### **Importance of Management**

The double rail restrainer provides the tools which make humane handling and stunning easier and more efficient. It is however, only as good as the management that goes with it. Plants which have humane handling and stunning practices have a manager who enforces a strict code of conduct. Plants with rough handling and bad stunning, almost always have poor management.

Animal welfare is becoming an increasing concern. Progressive slaughter plant managers are becoming sensitized to the issue and realize the importance of humane treatment of livestock.

### **Conclusion**

**Eight double rail restrainer systems are now operating in commercial beef slaughter plants at hourly production rates of 100 to 400 cattle per hour. The double rail is more humane, efficient and safer for employees than the V restrainer it replaces.**



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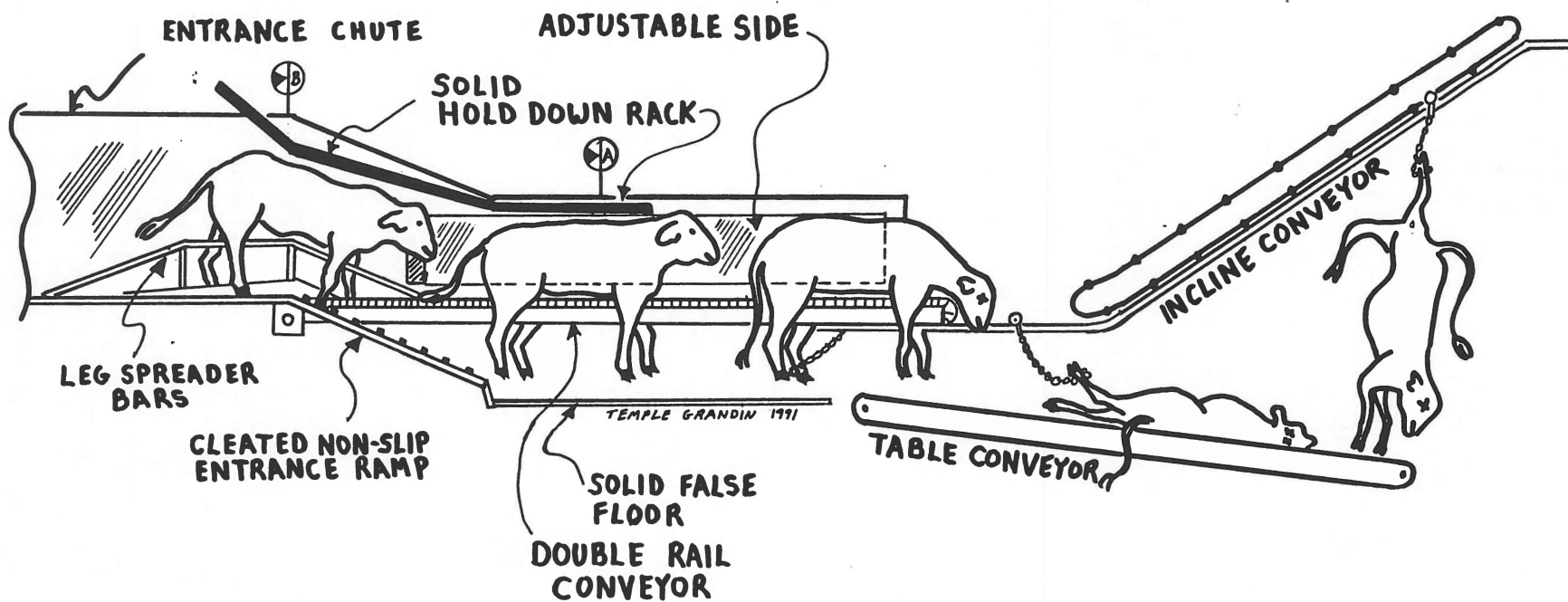


Figure 1. Elevation of double rail restrainer system.



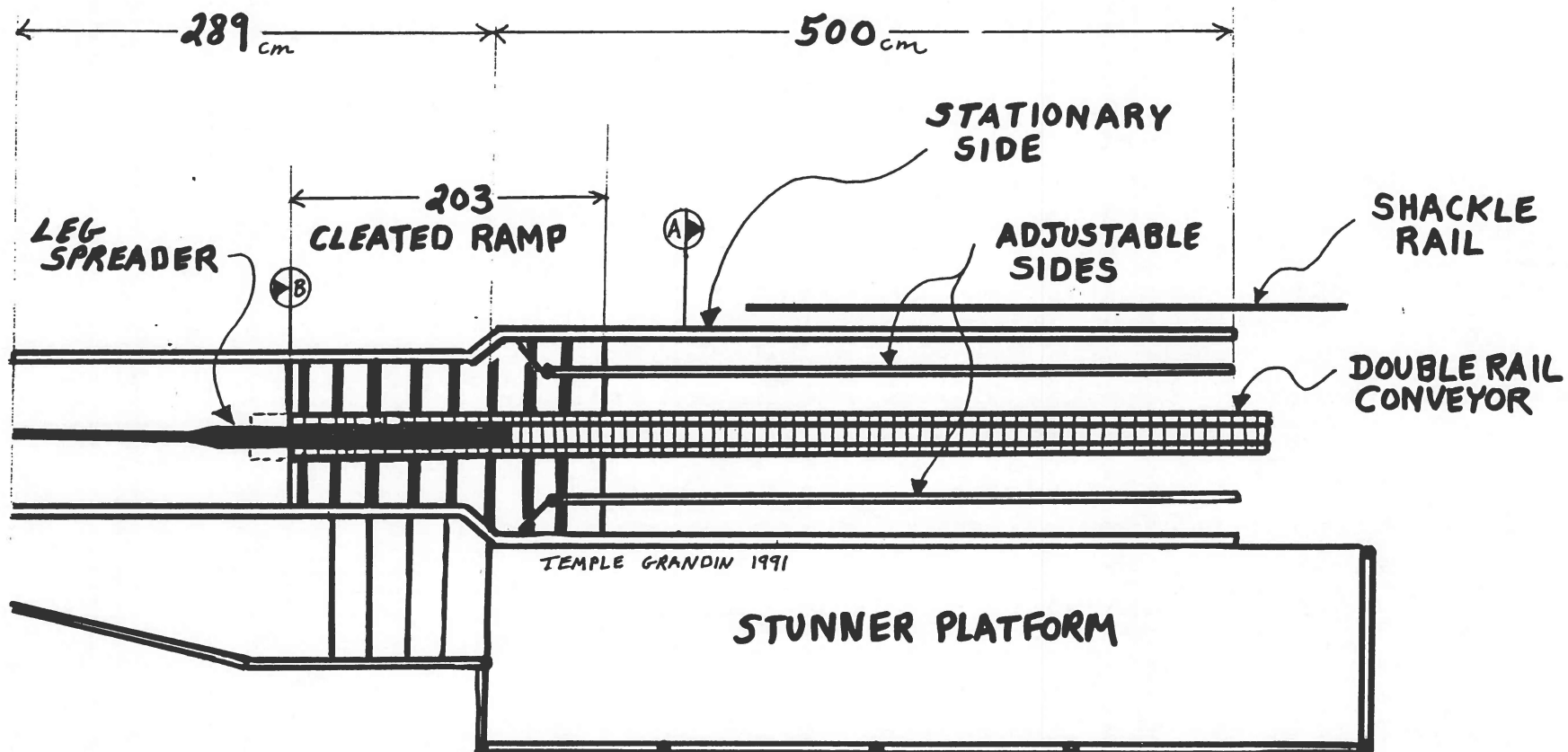


Figure 2. Layout of double rail restrainer.



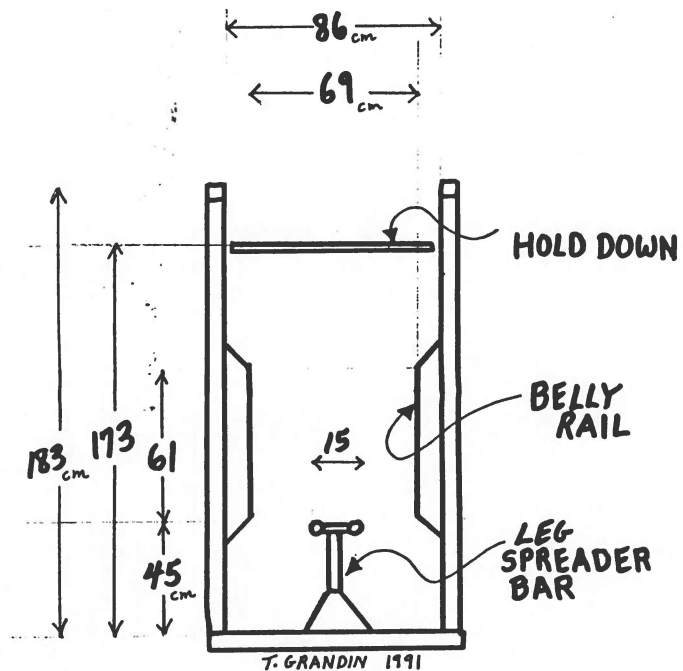


Figure 3. Cross section through restrainer entrance.

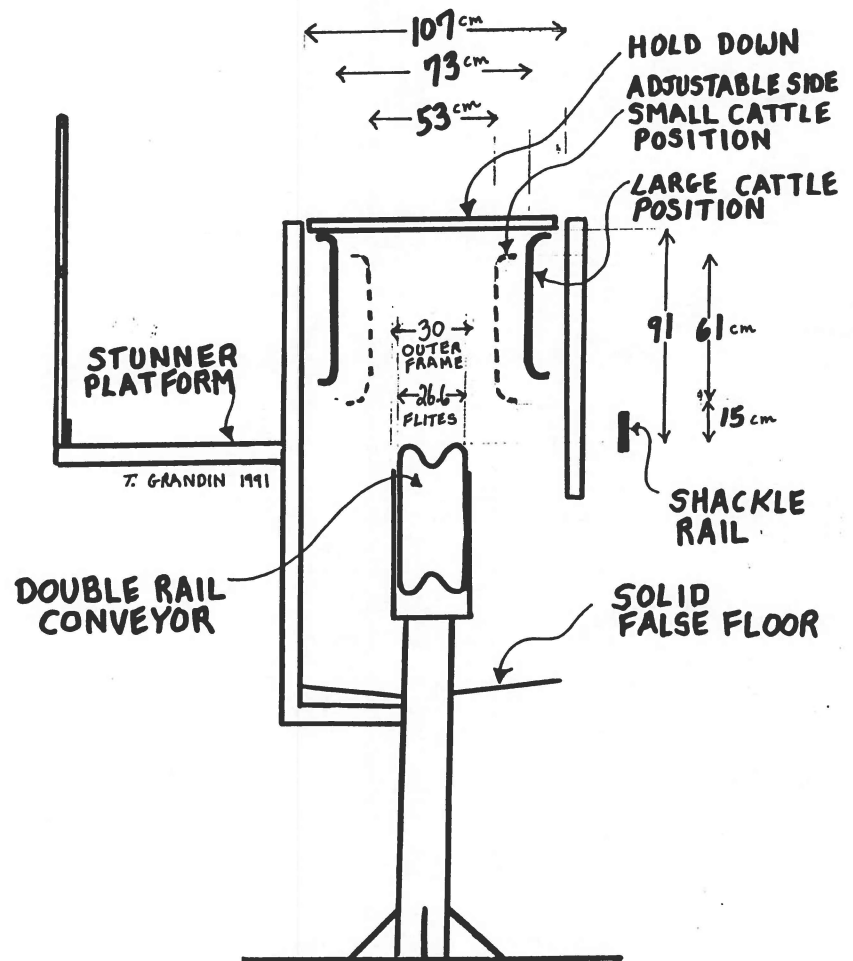
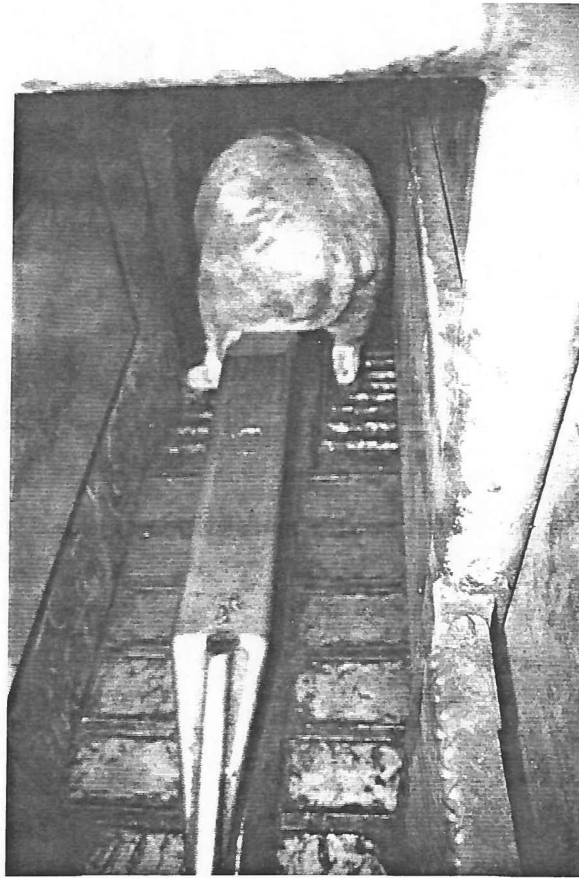


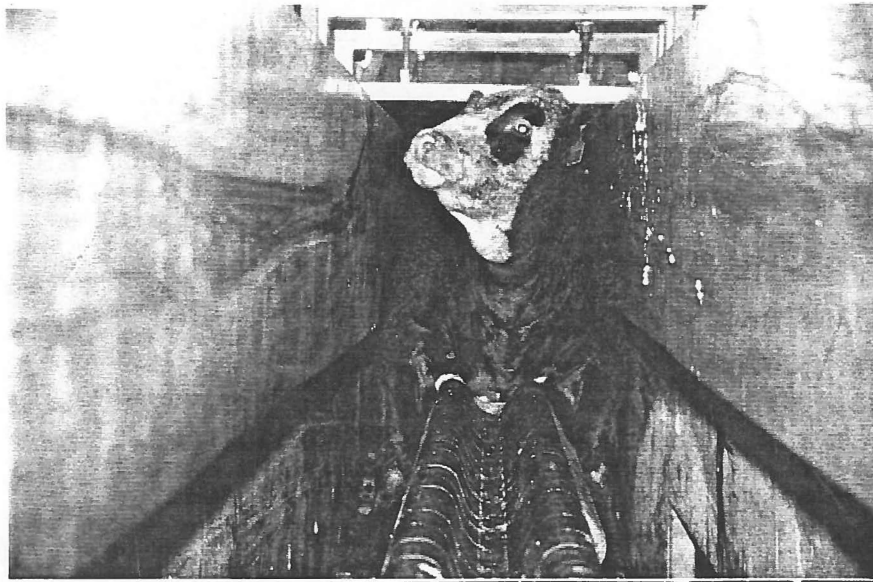
Figure 4. Cross through restrainer and hold down rack.





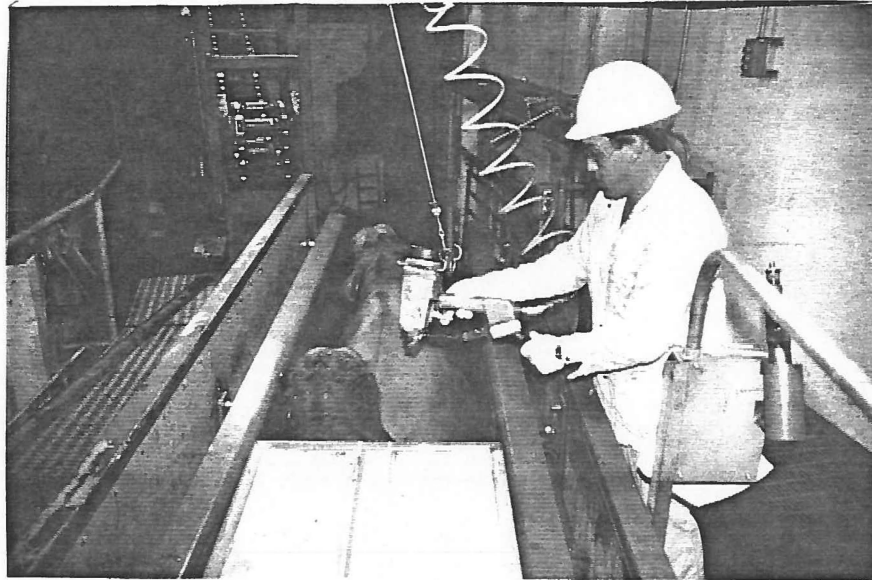


**Figure 5. Animal walking down the cleated non-slip entrance ramp into the restrainer.**

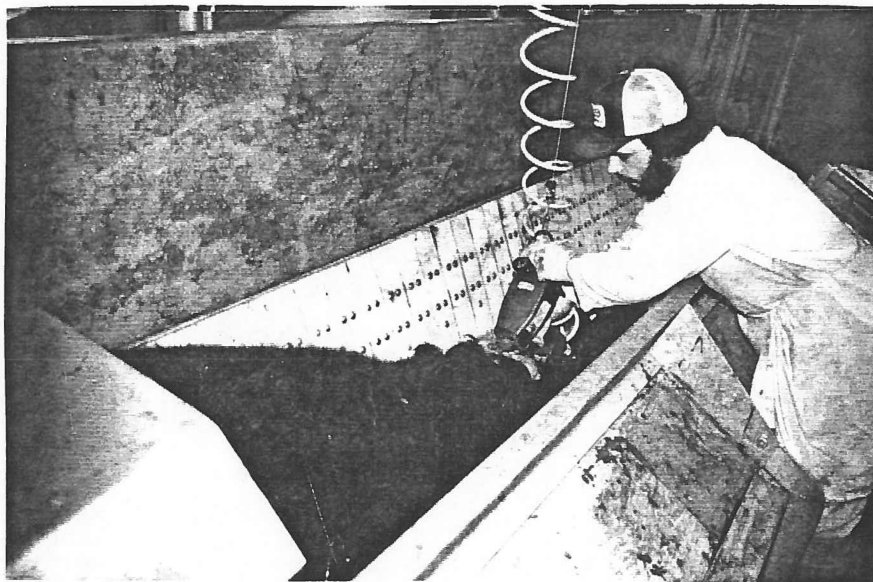


**Figure 6. Steer riding on the double rail restrainer in the correct position for stunning. Note how the shape of the double rail conveyor fits his brisket.**



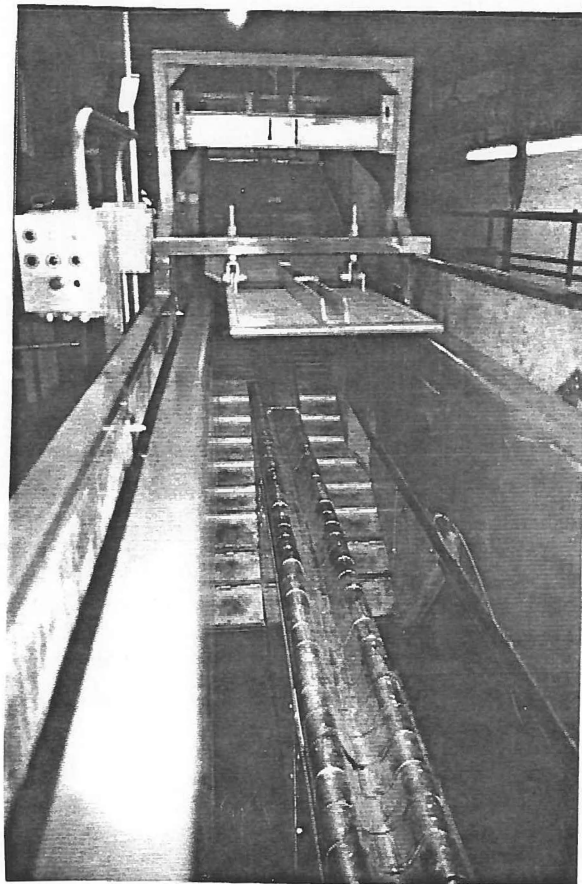


**Figure 7. Cattle being stunned. The stunner operator has straight posture which reduces back strain and improves stunning accuracy.**



**Figure 8. Stunner operator in the old style V restrainer has to bend over to stun cattle.**





**Figure 9. Overall view of double rail restrainer showing hold down rack, restrainer conveyor and adjustable sides.**

